USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Sequoia National Forest | August 2024

Borel Fire Burned Area Summary

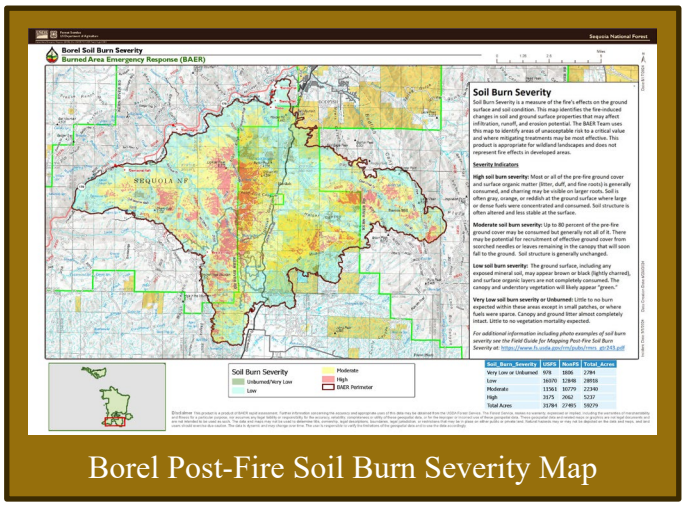
Burned Area Report

Fire Background

On July 24, 2024, the Borel Fire started on the south side Highway 178 near the Democrat Fire Station on the Kern River Ranger District on the Seqouia National Forest in Kern County. It burned in the Breckenridge and Piute Mountains. There were unusually hot temperatures and winds with a fire weather warning that led to rapid spread of the fire within a few days of ignition.

While many wildfires cause minimal damage to the land and pose few threats to the land or people downstream, some fires result in damage that requires special efforts to reduce impacts afterwards. The Burned Area Emergency Response (BAER) program is designed to identify and manage potential risks to resources on National Forest System lands and reduce these threats through appropriate emergency measures to protect human life and safety, property, and critical natural or cultural resources. BAER is an emergency program for stabilization work that involves time critical activities to be completed before damaging events to meet program objectives.

The Forest Service assembled a BAER team on August 12, for the Borel Fire. This team of experts in various resource disciplines began assessing the post-fire effects to critical values on Forest Service lands. Impacts to the soil are the primary indicator of potential post-fire changes in watershed response, as well as watershed recovery. The team developed soil burn severity (SBS) maps to document the degree to which the fires had changed soil properties. Using the SBS map, physical scientists can predict erosion potential, changes to runoff and flood flows, and increased geologic hazards. Field evaluations and modeling results are used to determine relative increases in post-fire risk to different critical values and inform recommendations to address these increased risks.



Borel Post-Fire Soil Burn Severity Map

Soils

Soil burn severity is not an assessment of vegetation consumption, but rather an integration of vegetation loss, changes in soil structure and infiltration capacity, remaining vegetation, duff, or ash, and soil color, all of which may indicate relative degrees of soil heating.

The final soil burn severity maps were developed with ESRI ArcGIS software using satellite-imagery-derived Burned Area Reflectance Classification (BARC) and field survey data. Field work included assessment of ash characteristics, ground cover, root condition, soil structure, soil water-repellency, and vegetation burn severity as described in the Field Guide for Mapping Post-fire Soil Burn Severity (Parsons et al. 2010). High burn severity is characterized by a complete consumption of organic material with the surface layers of the soil resulting in a change to single-grain structure. Fine roots are commonly charred or consumed 3-5 cm deep. The highest-severity areas often have a loose, dusty appearance, and no longer have any cohesion or soil strength. Generally, there will be less destruction of soil organic matter, roots, and

structure in an area mapped as moderate compared to high. In areas mapped as moderate SBS, soil structure, roots, and litter layer may remain intact beneath a thin ash layer. Low soil burn severity results in very little alteration of soil organic matter and little or no change in soil structural stability.

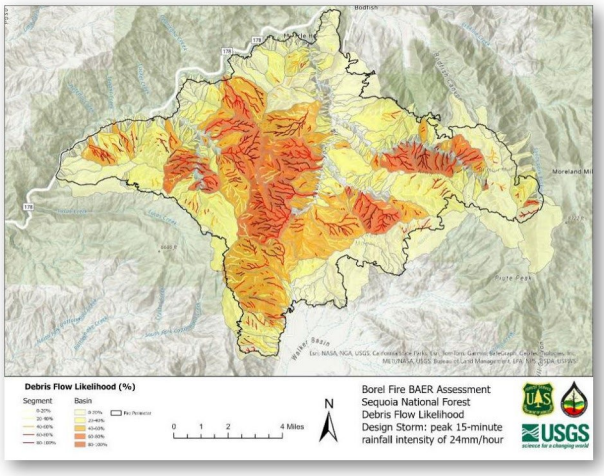
Mapped and validated SBS for the burned area is High (9%), Moderate (37%), Low (49%), and Very Low/Unburned (5%) (see map on [insert page number]). The more severe a fire's effects are on the soil, the more likely those soils will erode in subsequent rainstorms – especially in locations with steep slopes. Erosion after fires can cause tremendous damage to homes and other structures in the years after a fire.

Developed areas (both urban and rural) were not mapped for soil burn severity. This method has been developed for wildland vegetation and landscapes and therefore is not appropriate for describing effects of fire on developed lands and burned structures. As such, these areas were not visited or evaluated by the BAER team.

Geology

The team identified the geologic conditions and processes that have shaped and altered the watersheds and landscapes and assessed the impacts from the fire on those conditions and processes that could affect downstream critical values. Using the understanding of rock types and characteristics, geomorphic processes, and distribution of geologic hazards helps predict how the watersheds will respond to and be impacted by upcoming storms. The Borel Fire occurred in an area dominated by granitic rocks with local "roof pendants" or inclusions of metasedimentary rock.

The team provided soil burn severity field data to the US Geological Survey (USGS) Landslide Hazard Program to assist in forecasting the probability, potential volumes, and hazards of debris flows through their developed empirical models. (See Borel Post-Fire Debris Flow Likelihood Map Below)



Borel Post-Fire Debris Flow Likelihood Map

The USGS debris flow analysis of the Borel burn area presented debris flow hazard classes, probability of occurrence, and volumes of materials occurring for multiple precipitation events. The BAER team selected a design storm of a peak 15-minute rainfall intensity of 24 millimeters per hour (0.9 inch/hr.) rate to evaluate debris flow potential and volumes, based on the NOAA Atlas 14 Point Precipitation Frequency Estimates for a one-year return interval for this area.

Debris flow probability and volume were estimated for each basin in the burned area as well as along the upstream drainage networks, where the contributing area is greater than or equal to 0.02 km², with the maximum basin size of 8 km². Streams that exceed an upslope watershed area of 8 km² were added as "Watch-streams" features, representing streams susceptible to flood and possibly debris-flow hazards (e.g., Clear Creek watershed).

It is important to emphasize that local data (such as parent material and debris supply) influence both the probability and volume of debris flows. Unfortunately, local specific data are not presently available at the spatial scale of the post-fire debris-flow hazard assessment done by the USGS. As such, local conditions that are not constrained by the model may serve to dramatically increase or

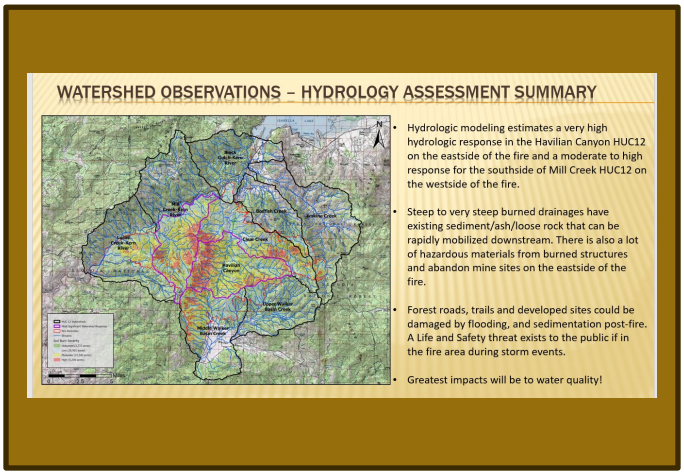
decrease the probability and (or) volume of a debris flow at a basin outlet.

The highest debris flow potential is in Havilah Canyon from both west and east-facing slopes. This is supported by the USGS debris flow model under conditions of a peak 15-minute rainfall intensity of 24mm/hr. (0.9 inches/hr.) showing probabilities ranging from 60-100% and the presence of legacy debris flow deposits along the eastern flank of the Breckenridge Mountains in drainages adjacent to the community of Havilah such as Goff Ranch (Don Lindsey, personal communication, 2024). As such, the CalFire Watershed Emergency Response Team (WERT) conducted a detailed analysis of debris flow potential for the Havilah Canyon, and the reader is encouraged to review their report for further details.

Although Havilah Canyon is most susceptible to debris flow hazard, the drainage just east of the Havilah Fire Station (Dutchman Creek/Havilah Canyon) did not show evidence of legacy debris flow deposits, nor did the surrounding hillslopes show much potential for debris flow initiation. Lack of legacy debris flow deposits may indicate that hyper-concentrated flows and nuisance sedimentation may be more likely for this site.

With over 100 mines in the burn area around Havilah Canyon, there is also an increased risk of mining-related waste rock and arsenic-laden fine-grained tailings being entrained in hyper-concentrated flows or debris flows, which could deposit sediments with high concentrations of arsenic and/or flush the arsenic-ladened fine-grained tailings as suspended or wash load into Clear Creek and eventually the Kern River.

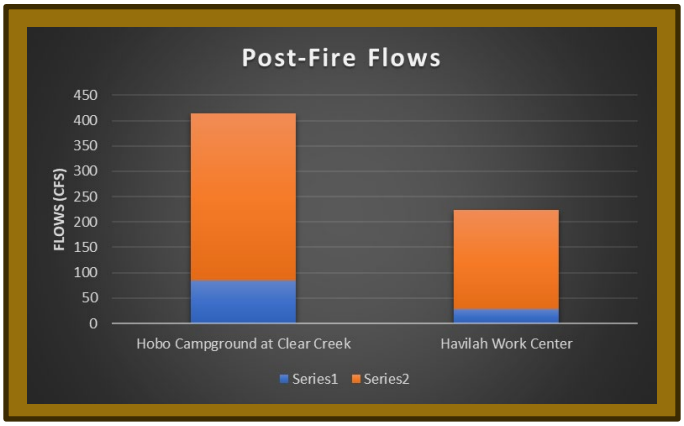
Hydrology

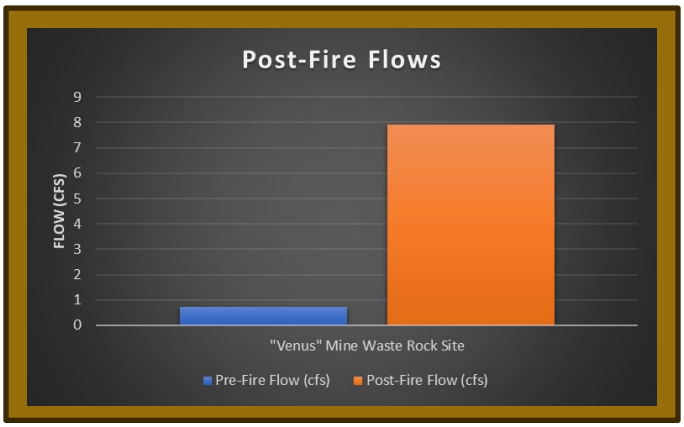


Primary watershed response is expected to include an initial flush of ash and burned materials, erosion in drainages and on steep slopes in the burned area, increased peak flows and sediment transport and deposition, and debris flows. Watershed response is dependent on the occurrence of rainstorms and rain-on-snow events and will likely be greatest with initial storm events. Increased watershed response is most likely in areas with high to moderate soil burn severity. Disturbances will become less evident as vegetation is reestablished, providing ground cover that reduces erosion and increases surface roughness which slows flow accumulation and increases infiltration.

The Borel Fire can be separated into two distinct areas, northwest of Hobo Ridge, down to Highway 178 and the Kern River, and southeast of Hobo Ridge down to the town of Havilah and extending into the Piute Mountains. For these two areas, we expect to see different hydrologic responses due to differences in geomorphology and the different severities of the burn. While there is the potential for flooding impacts to some BAER critical values,

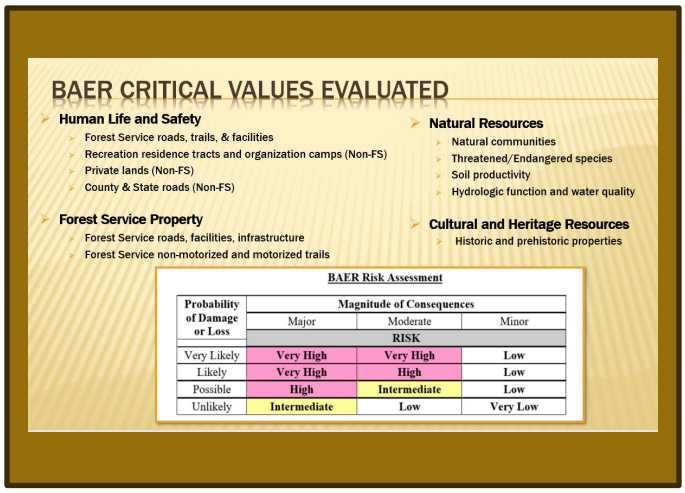
the biggest concern is to water quality.





Critical Values

The first critical value BAER teams assess is always human life and safety on National Forest System lands. During and after heavy rainstorms, Forest Service employees and visitors to National Forest System Lands could be threatened by floodwaters and debris flows. In addition, users of roads within and downstream of the burned areas may be affected by road washouts during and after heavy rainstorms. The National Weather Service can establish an early warning alert plan for areas that are potentially at risk from these events. The BAER team recommends general warning signs and communications to travelers on any National Forest System roads and trails within or directly adjacent to the Borel Fire.



Roads and Bridges

Roads in and downstream of burned areas are at risk of damage due to post-fire conditions. The most likely threat due to the fires is clogging of culverts, bridges, and other in-channel infrastructure from the higher levels of floatable debris (especially burned trees) in burned watersheds. Once blocked by debris, road drainage structures no longer function and the stream flows over the road, often causing considerable damage and limiting access. Various measures can reduce this risk, including protecting culvert inlets with debris racks, removing large structures before floods, and making heavy equipment available and readily mobilized during storm events to keep structures clear of debris.

Debris flows are less likely than debris-laden flood flows, but they pose a greater threat to roads when they do occur and are difficult to mitigate.

Critical values addressed in the BAER report include Forest Service System Roads and related drainage features. There are 33 miles are within the Borel Fire perimeter and approximately 26 miles evaluated for assessment. The BAER team determined that 13.24 miles of roads were assessed at very high or high risk, and 19.26 miles of roads were assessed to be a low risk. Priority Forest Service roads proposed for emergency stabilization treatments are Breckenridge, Saddle Springs, and Cow Flat roads.

Treatments for the protection of these roads include restore drainage function, armor drainage crossings, install drainage features, upsizing culvert, storm inspection and Response, and warning signs.

Recreation

National Forest System recreation infrastructure includes campgrounds, trails, and day use areas. Most of the recreation assets within the Borel Fire burned area relate to campgrounds and trails. Like roads, recreation infrastructure could be damaged in post-fire storm events.

The team proposes temporary campground and trail closures, warning signs and public messaging, and trail drainage stabilization treatments, which include armoring and/or cleaning existing water control features and adding additional drainage features to provide additional capacity for elevated sediment laden post-fire runoff.

Botany

Invasive plants adversely affect native plant communities through allelopathy (suppression of growth of a native plant by release of a toxin from a nearby invasive plant) and direct competition for water and resources. Over time, native plant diversity decreases as invasive plants expand, reducing habitat for native plant species and wildlife. Shifts from diverse native plant communities to non-native invasive plant dominance could alter future fire behavior, intensity, extent, and season of burning.

Current infestations of Spotted knapweed, Yellow star thistle, and Tree of heaven are primarily located along roads, old dozer lines, campgrounds, and trails throughout the burned area, with interior areas being largely un-infested. However, the burned area creates conditions for invasive species to outcompete native plants.

The team recommends a treatment of Early Detection, Rapid Response (EDRR) to monitor for noxious weed infestation and expansion in areas disturbed due to mechanical suppression activity and burned areas prone to new noxious weed infestations.

Suppression features to be treated by EDRR are 9 miles of dozer line and 8 miles of handline were prioritized for treatment because they were the ends of the dozer lines and /or they intersected sensitive plant populations, trails, or streams; 11 safety zones, 10 drop points, 1 dip site, and 2 heli-spots.

Other National Forest Systems areas within the Borel Fire perimeter to have EDDR treatments include 2 miles of trails; 1.5 miles of stream corridors; 11 acres of meadow; and areas of repair work completed by the Southern California Edison (SCE) power company due to fire damage.

Hazmat

The Borel Fire burned two Forest Service trailers located at the Forest Service Havilah Work Center and abandoned mine tailings (Havilah Tailings) west of the work center, all of which are located on National Forest System lands. The destruction and damage caused by the fire that burned the trailers and abandoned mine tailings created hazardous material (hazmat) contamination that is now exposed to the environment.

There is a threat of hazmat moving off NFS lands into surface water downgradient of the Havilah Tailings due to loss of vegetation resulting in mine tailings that are easily mobilized during flood events and overland flow. Beneficial uses of downgradient surface water (Kern River) include drinking water.

Also, within the Borel Fire perimeter are privately owned burned structures and many abandoned mines and remnants of mining activities that could potentially threaten human life and safety, and natural resources. The threat to NFS lands is due to the hazmat from the burned structures, tailings, and waste rock that will mobilize in stream channels downslope with the anticipated increased post-fire runoff and transport mine related hazmat materials depositing onto NFS lands.

The BAER assessment team recommended emergency stabilization treatments for the areas located on NFS lands. For the non-NFS locations, the team coordinated their findings with the appropriate landowner and/or agency.

Cultural Resources

The most typical post-fire threats to cultural sites are physical threats such as erosion or damage from (now dead) falling trees. In some cases, newly exposed artifacts are threatened by human damaging activities such as looting or vandalism. Cultural resources were evaluated by the team and treatments proposed as necessary to protect these values from post-fire threats.

Federally Listed Species - Wildlife and Fisheries

No Federally listed species are present in the Borel Fire footprint.

Anticipated Vegetation Recovery

Post-fire recovery varies greatly based on climate, vegetation types and burn severity. It is typical for recovery to take between 3-5 years for reestablishment of ground cover. The persistence of drought in the years following wildfires also delays the recovery time frame. Even with only a short period of time since fire containment, resprouting of trees and shrubs as well as emergence of forbs have been noted within the burned area.

Non-Forest Service Values

Since fire effects know no administrative boundaries, additional threats exist for assets not owned or managed by the Forest Service. Post-fire emergency response is a shared responsibility. There are several federal, state, and local agencies that have emergency response responsibilities or authorities in the post-fire environment. The BAER team and local unit BAER Coordinator engaged with interagency partners to facilitate consideration of off-Forest values covered through other programs with the relevant responsible entities. The BAER Team shared analysis, findings and reports with partner agencies that have responsibility and authority to work with private land owners and businesses and can assist them with developing post-fire response plans and mitigations.

Partner agency contacts:

Natural Resources Conversation Service, Bakersfield Field Office, Amy Rocha, Amy.rocha@usda.gov; https://www.nrcs.usda.gov/programs-initiatives/ewp-emergency-watershed-protection

Kern County Office of Emergency Services, caomailbox@kerncounty.com

Kern County Fire Department, fireinfo@kerncountyfire.org

California Watershed Emergency Response Team (WERT), Don Lindsay, Don.Lindsay@conservation.ca.gov, What's a WERT? (ca.gov)

California Watershed Emergency Response Team (WERT), David Cavagnaro, David.Cavagnaro@conservation.ca.gov, What's a WERT? (ca.gov)

National Weather Service – Hanford Office, Felix Castro, Felix.castro@noaa.gov

Conclusion

There are multiple phases of post-fire actions after a wildfire covering suppression repair through long-term recovery. BAER is the rapid assessment of burned watersheds by a BAER team to identify imminent post-wildfire threats to human life and safety, property, and critical natural or cultural resources on National Forest System lands and take immediate actions to implement emergency stabilization measures before the first major storms. The BAER team has identified imminent threats to critical values based on a rapid assessment of the area burned by the Borel Fire. The assessment was conducted using the best available methods to analyze the potential for damage from post-fire threats, including flooding and debris flows. The findings provide the information needed to prepare and protect National Forest System critical values against post-fire threats. The recommended BAER treatments in this report are not yet approved or funded. Because of the emergency nature of BAER, initial requests for funding of proposed BAER treatments are supposed to be submitted by the Forest Supervisor to the Regional Office within 7 days of total containment of the fire. The Regional Forester's approval authority for individual BAER projects is limited. Approval for BAER projects exceeding this limit is forwarded onto the Washington Office.

BAER treatments cannot prevent all the potential flooding or soil erosion impacts, especially after a wildfire-changed landscape. It is important for the public to stay informed and prepared for potentially dramatic increased run-off events. Many burned-area watersheds were already hydrologically responsive to rainfall and prone to erosion and sediment transport prior to the fire and will likely be even more responsive due to post-fire conditions. However, vegetation recovery is anticipated to be rapid with ground cover approaching pre-fire conditions within 1-3 years, which will attenuate any post-fire effects on watershed processes. The Forest Service will continue to provide information and participate in interagency efforts to address threats to public and private values resulting from the Borel Fire. Information can be found on-line at Casqf Borel Postfire Baer Information | InciWeb (wildfire.gov).

The Forest Service will continue to work towards long-term recovery and restoration of the burned area in coordination with efforts to rebuild and restore the communities affected. A vegetation burn severity map, or mortality map, may be produced as a part of the recovery efforts to help other scientists, such as wildlife biologists, botanists, and silviculturists understand what to expect from this changed landscape for wildlife habitat, invasive weeds, timber salvage, and reforestation needs.

Local Forest Service Leadership

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Local Forest Service BAER Coordinator

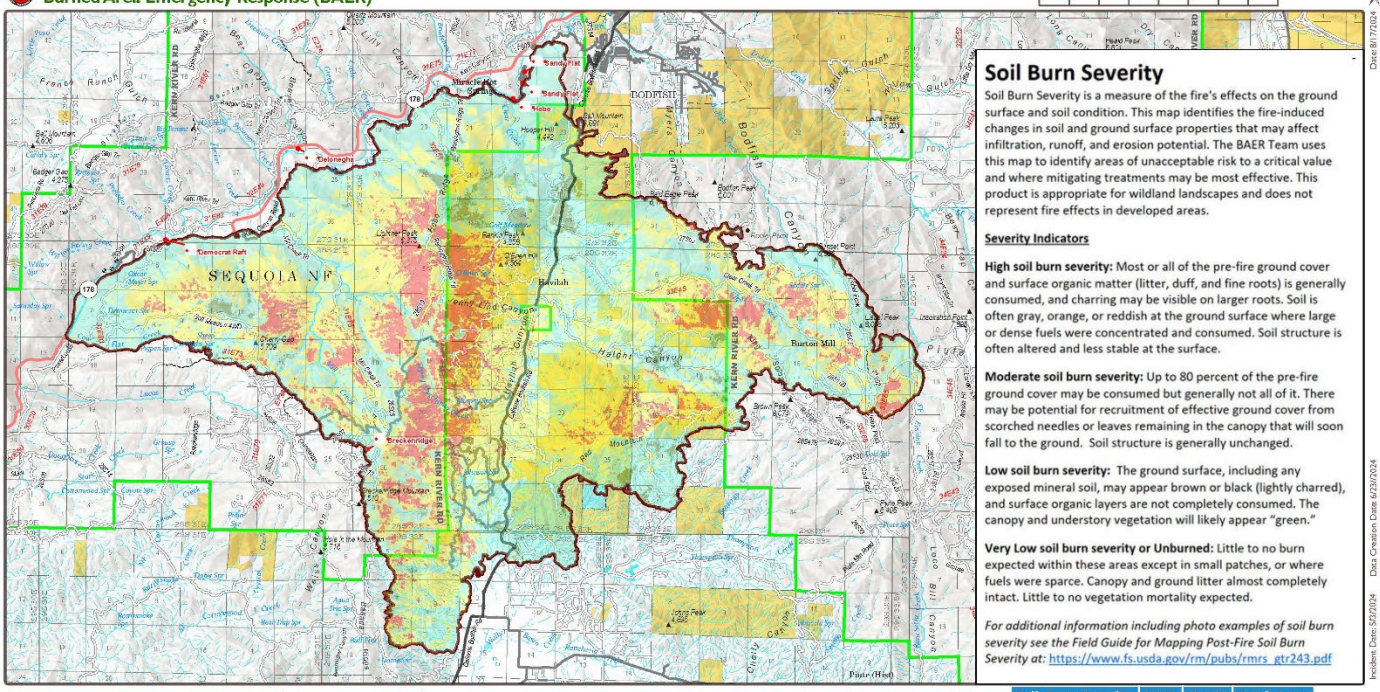
Andy/Keith Stone, Sequoia National Forest, Forest BAER Coordinator, keith.stone@usda.gov

References:

Parson, Annette; Robichaud, Peter R.; Lewis, Sarah A.; Napper, Carolyn; Clark, Jess T. 2010. Field guide for mapping post-fire soil burn severity. Gen. Tech. Rep. RMRS-GTR-243. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 49 p. (https://www.fs.usda.gov/rm/pubs/rmrs_gtr243.pdf)

Borel Soil Burn Severity

Burned Area Emergency Response (BAER)



Soil Burn Severity

Soil Burn Severity is a measure of the fire's effects on the ground surface and soil condition. This map identifies the fire-induced changes in soil and ground surface properties that may affect infiltration, runoff, and erosion potential. The BAER Team uses this map to identify areas of unacceptable risk to a critical value and where mitigating treatments may be most effective. This product is appropriate for wildland landscapes and does not represent fire effects in developed areas.

Severity Indicators

High soil burn severity: Most or all of the pre-fire ground cover and surface organic matter (litter, duff, and fine roots) is generally consumed, and charring may be visible on larger roots. Soil is often gray, orange, or reddish at the ground surface where large or dense fuels were concentrated and consumed. Soil structure is often altered and less stable at the surface.

Moderate soil burn severity: Up to 80 percent of the pre-fire ground cover may be consumed but generally not all of it. There may be potential for recruitment of effective ground cover from scorched needles or leaves remaining in the canopy that will soon fall to the ground. Soil structure is generally unchanged.

Low soil burn severity: The ground surface, including any exposed mineral soil, may appear brown or black (lightly charred), and surface organic layers are not completely consumed. The canopy and understory vegetation will likely appear "green."

Very Low soil burn severity or Unburned: Little to no burn expected within these areas except in small patches, or where fuels were sparce. Canopy and ground litter almost completely intact. Little to no vegetation mortality expected.

For additional information including photo examples of soil burn severity see the Field Guide for Mapping Post-Fire Soil Burn Severity at: https://www.fs.usda.gov/rm/pubs/rmrs_gtr243.pdf

Soil Burn Severity
- Unburned/Very Low
- Low
- Moderate
- High
- BAER Perimeter

Soil_Burn_Severity	USFS	NonFS	Total_Acres
Very Low or Unburned	978	1806	2784
Low	16070	12848	28918
Moderate	11561	10779	22340
High	3175	2062	5237
Total Acres	31784	27495	59279

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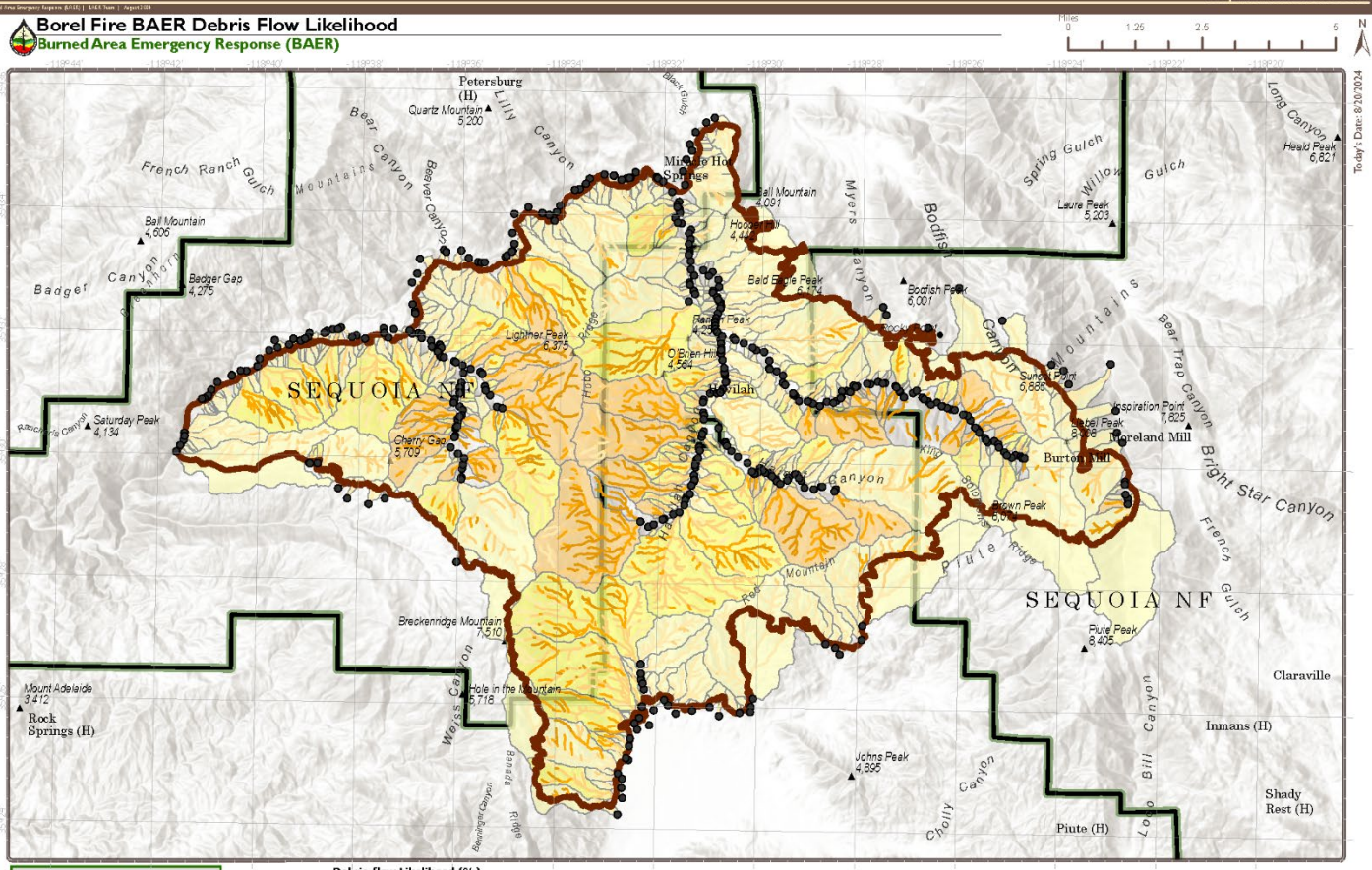
Borel Fire BAER Debris Flow Likelihood

Burned Area Emergency Response (BAER)



Debris-flow Likelihood (%)

	Segment	Basin
Basin Outlet		
Wildfire		
	0-20%	0-20%
	20-40%	20-40%
	40-60%	40-60%
	60-80%	